MARCH, 1920 EXTENSION CIRCULAR No. 104

THE COTTON BOLL WEEVIL

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INTRODUCTION.

The cotton boll weevil (**Anthonomus grandis, Boh**)* invaded the Southern tip of Texas in 1892, coming from Mexico. It reached Louisiana in 1903, Mississippi in 1907, Alabama in 1910, Georgia in 1915, South Carolina in 1917, North Carolina in 1919.

In North Carolina the first positive evidence of boll weevil was found at Tabor, Columbus County, on October 15, 1919.

Its spread has always been most rapid in the low warm region of the coastal plain where there is greater rainfall, milder winter climate, and ranker growth of the cotton plant. Its injuries are likewise more serious in these same regions.

This circular, intended for distribution in spring of 1920, is designed to set forth the probabilities for North Carolina, the means of preparation, and to explain the methods which can be used against the weevil.

Much depends upon cool confidence, well laid plans, modified methods of cotton culture, other crops to supplement cotton, and more attention to livestock—all these are mentioned.

The entomological phase of the problem involves gathering of squares, disposal of stalks, and poisoning of weevils—and these methods are quite fully set forth in this circular.

PAST HISTORY.

Soon after the cotton boll weevil appeared in Texas, publications of the United States Department of Agriculture gave warning that it would likely become the most serious insect pest of cotton in this country. This has proven abundantly true; yet time, return of confidence, adoption of methods of offsetting the loss or making up for it by other crops, changed methods of cotton culture, livestock, and methods of fighting the weevil directly, have all combined to enable the cotton states to maintain nearly the normal production that would, presumably, have been maintained if the weevil had not come.

This has not been because the boll weevil has died out or become less of a pest than formerly. Many factors have entered into the case, new areas have been devoted to cotton, and to some degree a new generation of cotton farmers has come on the stage, so that while the weevil continues serious and often inflicts heavy losses on many growers, the total yield from the whole region maintains a high level.

*Order *Cleoptera*, Family *Curculionidae*.

The general experience has been that beginning the second ye after first invasion, there follows a period of from three to five yea in which cotton growing is especially irregular and uncertain. E the end of that time, confidence begins to return and gradually th production of cotton increases until it may in some years reach th old level, or even exceed it. Yet there are many sections, especiall in the warmer parts of the Gulf Coast plain where the acreage yie does not yet reach the old figures.

DISTRIBUTION AT THIS DATE (April, 1920)

At the present time (April, 1920) the boll weevil occupies th greater part of the cotton belt of the United States. There are y considerable cotton areas in west Texas and in Oklahoma which th boll weevil has not occupied. In that region it occupies less territor that it did a few years ago, but that region is quite different from an part of North Carolina, it furnishes less of shelter for the weevil t hide in for winter, it has a hotter and drier summer climate, and colder winter climate, all of which is unfavorable to the weevil. I Arkansas, Tennessee, Georgia and South Carolina, the area occupie by the weevil comes close to the utmost limits of cotton culture, an it is only reasonable to expect that, as it becomes acclimated, it wi occupy all of the cotton region, at least in Georgia and South Caro lina.

In North Carolina it is at present established only in the southeas corner—including the entire counties of Brunswick and New Hanove —southern two-thirds of Columbus—southern one-third of Pender— eastern tip of Bladen—southern tip of Robeson. All of this area, an much new territory in South Carolina, was invaded during the regu lar fall migration (Sept., Oct.) of 1919.

As all of the cotton area of North Carolina is to the east of th Blue Ridge,* where climate and rainfall are influenced by the ocean it is reasonable to believe that the boll weevil can, and will, eventu ally invade and adapt itself to all of our cotton growing area.

REASONABLE EXPECTATIONS AS TO FUTURE SPREAD.

There is no fixed regularity in the rate of spread of boll weevil but on a general average it has advanced about 50 miles per year— more than this in the lower coast plain section, and less in the higher Piedmont. Its invasion of new territory takes place chiefly during September and October. Its advance in autumn of 1919 was greater than usual, covering fully half of South Carolina, extending into the southeastern corner of North Carolina, and close to the State line from Union County eastward to Robeson.

*Small patches of cotton are sometimes grown in some of our southern mountain counties bordering on Tennessee, but only for local use in pillows, cushions, mattresses, etc.

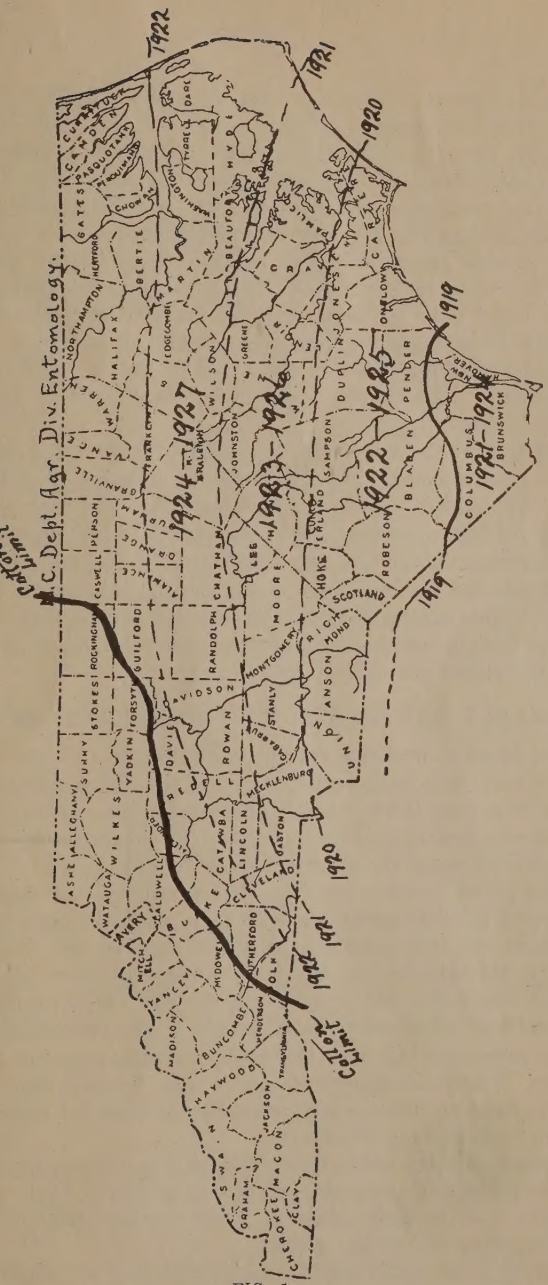

FIG. 1.

Reasonable expectation for spread of boll weevil in North Carolina, 1919 to 1922. ased on past *averages*. Spread will probably be more irregular than indicated. Dates etween the lines indicate probable readjustment period.

It should be clearly understood that our estimate of its future spre is based on the averages of its past record—it is merely an estima But as many farmers wish to know when they should expect it to rea them, we have indicated on an accompanying map (Fig. 1) the li which it had reached at the close of 1919, and the approximate loc tion of the lines which we may **reasonably expect** it to reach with the next several years. We may expect the area north and west line "1922" to be invaded later. We do not care to venture a gue as to the exact date for occupying the last of the cotton area. Th whole map is intended to show the general probabilities, as an a to the understanding of the reader. We do not expect it will be e actly fulfilled. The western limit of cotton culture in the State marked by a heavy line.

In each zone on the map (Fig. 1) two dates are marked, showing a interval of four years. Thus in the zone invaded in 1919 there marked "1921-1924." This is to indicate that the four year perio from 1921 to 1924 (inclusive) we may expect to be the trying perio of readjustment under the losses inflicted by the boll weevil. Th same is indicated for the zones which may be invaded in 1920, 192 and 1922. This **trying period** is expected to begin with the secon year after first invasion—the first year after first invasion is usuall one of only slight losses from weevil.

REASONABLE EXPECTATION AS TO DAMAGE BY WEEVI

Just as there is no fixed regularity in the rate of spread by bo weevil, so also there is no regularity as to the damage done by it. It status at any time is very much affected by the weather condition that have gone before, and its course for the future in any season wi greatly depend upon the weather which follows.

In some years, in some localities, it has reduced the crop not mor than about 5 to 10 per cent, while in some years, in some localities, i has reduced the crop as much as 80 or even 90 per cent. Almos invariably, its injuries are heaviest in regions where the winter i mild, and where the summers are warm, with much rainfall. Thes same conditions of climate are favorable to the growth of "Spanis moss" on trees, and this moss is a favorite hiding-place for the weevil in winter. Hence in general terms it may be said that in region where the Spanish moss grows profusely, damage by weevil is likel to be more severe than elsewhere.

Likewise in regions where there is much low woods and other cover with rank growth of the cotton plant, the weevil is likely to be mor destructive than in higher country which is more cleared and wher the cotton plant makes less growth.

Taking all these conditions into account as best we can, we conclud that the southeastern corner of our State must expect the heavies

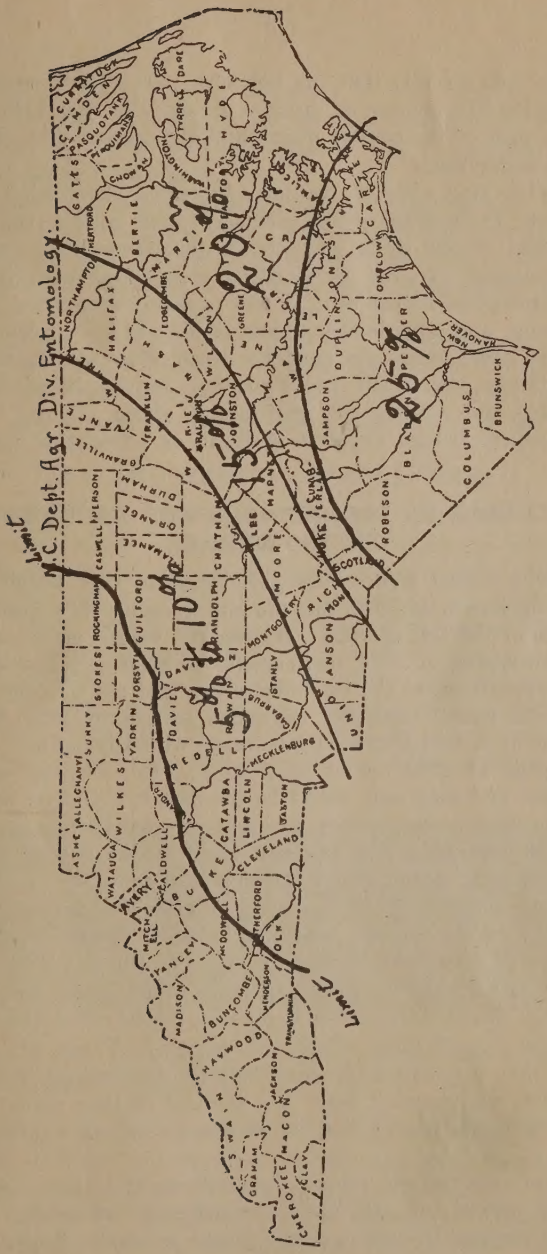

FIG. 2.

Conservative expectation of average reduced yield after weevil is fully established
direct methods against it are not fully used. Poisoning, gathering of squares, etc.,
re the methods to offset these losses. Damage will vary greatly from year to year.

damage by boll weevil; that the northern part of our coastal plai will come next in amount of injury; a belt with less injury acro the upper part of the coastal plain; and the higher, hilly, Piedmo section to suffer least.

On another map (Fig. 2) we have indicated about what we sha expect to be the **average** yearly damage to the cotton crop in thes several areas of our State. Of course the damage will vary fro season to season. In the southeastern area where we estimate th **average** damage as 25 per cent, it will probably sometimes be as lo as 5 per cent, and sometimes may run as high as 50 per cent, or eve more. The same variations must be expected in the other section These estimates may easily prove too low, but we have tried to b conservative, not wishing to create undue alarm.

The problem before us is to prevent or offset this prospectiv loss.

USUAL COURSE OF DISTURBANCE AND RECOVERY. TH TRYING PERIOD.

Suppose a cotton county has absolutely no boll weevil throug the growing season of 1920, but the entire county is covered by th migrations of the fall of 1920. During the winter many would di and in the spring of 1921 there would be relatively few survivor and these scattered, so the whole county would not be fully "seede down" with weevil until the migration in fall of 1921, by whic time the crop of that year would be made with slight loss.

The spring of 1922 would open with a full crop of weevils i hibernation, and that year would be the first full fledged boll weevi experience for a county which was first invaded in the fall of 192

The first year after first invasion is apt to be one of slight los from weevil—the second year is the first real test.

The first year of real test, second year after first invasion, may b one of very severe damage, resulting in much discouragement, or i may be one of very light damage, resulting in the rise of false hopes

Then follows the trying period of three to five years during whic the farmers finally learn from experience about what they have t expect, and adjust their affairs accordingly. Those who have s prepared that they can shift operations to other things if necessary are the ones who stand it best. By the end of that period of thre to five years, the county usually begins to get on a normal basi again.

Some farmers recover sooner than others, and there are usually some who neglect, or are unable to make the necessary modifica tions, and who are left permanently poorer as result of coming of the weevil.

County agents, banks, chambers of commerce and merchants can

aid greatly in tiding over this period of readjustment. We have learned the value of "morale" in meeting a difficulty. With reference to the boll weevil problem, it means careful planning, preparedness, coolness and confidence.

By the end of three to five years matters improve, more hogs, more corn, more potatoes, more beans, more forage, more confidence, and, finally, the production of cotton again increases until it may approach the old level, or even exceed it, with the surplus of other things in addition.

The trying period is more severe in "all cotton" sections than where there is already a well diversified agriculture. It is also more severe where weevil damage is greatest. Thus we must expect it to be more severe in the coastal plains section than in the Piedmont section.

LIFE AND HABITS OF BOLL WEEVIL.

THE WEEVIL ITSELF: The full grown adult cotton boll weevil, which punctures the squares and lays the eggs, is a winged beetle with close-fitting wing-covers, and with a snout about half as long as the body. Fig. 3 gives an idea of its general appearance slightly enlarged. The average size is about that of the one at the extreme right-hand in the picture. It is of a chestnut brown color, sometimes almost black, but a covering of yellow fuzz may make it look yellowish or almost gray, depending upon age and extent to which it has become rubbed off. The adult weevils are not especially active, rather slow and clumsy walkers, and not rapid runners like some beetles.

FIG. 3.
A Row of Adult Boll weevils, Giving an Excellent Idea of Their Size and General Appearance. Slightly Enlarged.
(After Photograph by Sanderson).

Finer Points to Distinguish Boll Weevils from Other Weevils: In Fig. 4 we show the boll weevil much enlarged, as viewed from above and from the side. Note the **snout** which is about half as long as the body, at the end of this snout are the strong small jaws, for it is truly a biting, and not a sucking insect. Note the antennae (feelers) which are elbowed and attached to the snout, these are not always easily seen in specimens as they are often folded against the snout.

FIG. 4.

MUCH ENLARGED PICTURE OF ADULT, SHOWING HAIRY COVERING, SNOUT, ANTENNÆ AND THE TWO SMALL TEETH ON PROJECTIONS ON THE FRONT LEG. LINE INDICATES TRUE SIZE.

(After W. D. Hunter, U. S. Department Agriculture, Farmers' Bulletin No. 189.)

Now comes the real point: Notice **carefully** the upper part, the part nearest the body, of the **front leg.** This part of the front leg is much thickened, with a projection which is notched near the tip so that it is divided into **two points** ("teeth"), one of these teeth being decidedly larger than the other. Also notice that the wing-covers are smooth, except for very fine parallel lines running lengthwise and the downy fuzz. We do not know of any other snout beetle of this size in the State whose wing-covers are as smooth as these and which have the **two teeth** on one enlarged projection on the upper part of the front leg. Notice the part of the body (thorax or prothorax) to which the front legs are attached. The fuzz usually lies in such manner as to make a more or less distinct stripe **lengthwise** this thorax. This is faintly indicated in Fig. 3.

The strawberry weevil, which is very close kin to the boll weevil, is smaller and has only one tooth on the front leg. The weevils which infest acorns, hickory nuts, etc., have only one tooth on the front leg. The peach and plum curculio have two teeth on the front leg, but the teeth are separated and the wing-covers are roughened. The cowpea pod weevil is blacker, does not have the fuzz, and the wing-covers have many round pits, not smooth like boll weevil. We have numerous other weevils which are decidedly larger or smaller than the boll weevil, or which are more slender bodied or more stout, or different length of snout.

Of our native weevils the ones infesting acorns, hickory nuts, pecans, etc., resemble the boll weevil more closely in size and appearance than any others. Many persons who consider themselves close observers have been deceived by them, as they are sometimes found on cot-

ton plants, even on the bolls. During the years 1903 to 1919, the finding of these nut weevils led to many false reports of boll weevil.

NOTE: Any farmer or any county agent who is located in advance of the known boll weevil area should send any suspected specimens to Division of Entomology, State Dept. Agr., Raleigh, N. C., in order to be certain of their identity. Harm results from mistaken declarations that boll weevil has appeared in a new community. It is important to ascertain the presence of boll weevil as soon as possible after it invades any locality, and this matter should be confirmed by sending specimens to this office.

PASSING OF WINTER—(HIBERNATION): The boll weevil passes the winter in the adult weevil stage of its life (Figs. 3, 4). It flies or crawls to suitable shelter, often in woods, along fence rows, ditches, around buildings, under trash, etc. Masses of Spanish moss are often chosen for hiding. It goes into hibernation after heavy frost, when cotton is dead, and must then go without food until cotton is up in spring, for, so far as known, **there is no food plant, except cotton in this part of the country upon which the boll weevil can live or in which its offspring can mature.**

EMERGENCE IN SPRING: The weevils emerge very irregularly in spring. In this latitude we may expect some to come out very soon after the cotton is up, while belated ones may still be coming out of winter quarters and into the fields as late as June. This irregularity makes it impossible to make a "clean sweep" of the weevils in early season, and later their numbers make it also impossible.

They feed at first to a limited extent on the tender growing terminal leaves, but when the buds, or squares, begin to form they feed on these, and the females lay their eggs in the squares. The squares wilt and drop. Still later they may feed on and lay eggs in the young bolls. Such bolls do not drop, nor mature. Several generations are produced during summer.

THE MIGRATION TO NEW REGIONS: Late in season, when early cotton is maturing, and when the weevils have destroyed many of the squares and young bolls that remain (in September) the weevils are seized with an impulse to seek new fields, and once on the move they fly by short stages for long distances, ten, twenty, fifty, perhaps a hundred miles. This spread continues until cold weather.

THE LIFE STAGES.

Like all other beetles the boll weevil has four distinct stages of life:

(1) **Egg**—laid by the adult, and hatches to larva or grub.

(2) **Larva or Grub**—hatching from egg, and when grown changing to pupa.

(3) **Pupa**—developed from larva or grub, and changing to adult

(4) **Adult**—developed from pupa—lays eggs and dies.

The round of life then begins with the egg again.

The Egg—The egg is very small, oval, and white in color. It i laid **inside** the square or boll, the female first making a hole with th snout, then laying the egg and forcing it down the hole. The hole i then sealed with a waxy substance. The average female weevil wil lay over 100 eggs before she dies. The egg hatches to the grub o larva in about 3 to 6 days.

The Larva or Grub—This is the stage of life which follows the egg The grub is of course very small at first, and even when grown is no over one-half inch long. It is white in color, usually lies somewha curled up, and does not have distinct legs. It feeds upon the develop ing parts of the square or boll. Its injuries cause the squares t turn yellow ("flare") and drop off; while infested bolls remain o the plants but do not open properly. The length of life of the larva from time of hatching from the egg until it changes to the pupa, i about one to two weeks, depending upon temperature, moisture amount of food, etc. In Fig. 5 at (a) a very young larva is shown in a square, at (b) a larger one. In Fig. 6 at left is shown a full grown larva, natural size, in a boll. When grown the grub changes to the pupa (shown at (c) Fig. 5).

The Pupa—This is the stage of life which follows the larva or grub. In this stage the insect takes no food, but goes through the change of form from the grub to the adult weevil, developing the legs, beak, wings and other organs. It goes through this stage still inside the

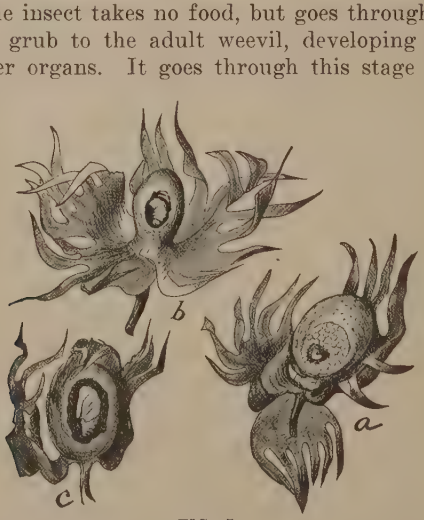

FIG. 5.

SHOWING STEPS IN DEVELOPMENT OF BOLL WEEVIL. *a*. YOUNG LARVA IN YOUNG SQUARE. *b*. LARVA NEARLY GROWN IN SQUARE. *c*. PUPA STILL WITHIN THE SQUARE. ALL NATURAL SIZE.
(After Howard, U. S. Department Agriculture.)

square or boll. The pupa is white in color. The pupa in a square is shown at (c) in Fig. 5. This stage of life lasts about four to eight days, exact time depending upon temperature, etc. At the end of that time, the adult weevil having developed inside, it sheds off the pupa skin and crawls forth.

FIG. 6.

At Right, a Boll Showing Feeding and Egg Laying-Marks. At Left, Boll Opened to Show Grown Larva Within Boll. Natural Size.
(After Howard, U. S. Department Agriculture.)

The Adult—This is the stage of life which follows the pupa, and is the active winged stage which has already been described and is shown in Figs. 3 and 4. Within a few days after emerging as adults, mating takes place and eggs are laid. This is the only stage of life in which the insect can move at its own will from boll to boll, from plant to plant, and from field to field, and it is the only stage in which reproduction can take place. The adults feed by means of small strong jaws at the end of the beak. This is also the stage in which the winter is passed. The adults die and the life story begins again with the egg. The adults spend much of the time under the bracts, or shuck, of the squares or bolls.

Generations or Broods—From egg to adult takes about two to four weeks, averaging perhaps three weeks; quicker in mid-summer and slower in cooler weather. Always remember that it is greatly influenced by heat, moisture and ease of securing food. If conditions favor, the earliest weevils to emerge in spring may have been the progenitors of as many as six or seven complete generations by the end of the season. On the other hand, if conditions are unfavorable to the weevil, the latest ones to emerge may leave only three or four generations by winter. Between these extremes we may expect that usually in this State four or five generations will be produced, but we would not expect these always to be clearly separated. From midsummer to frost we must expect to be able to find eggs, larvæ, pupæ

and adults all in the same fields at the same time. But when severe cold weather comes, eggs, larvæ and pupæ will perish, and only the adult weevils will live over till the next spring.

Cotton the only Food Plant—It is worthy of special emphasis that in all this southeastern region of the United States the boll weevil is not known to feed upon, or develop within, any plant but cotton.

MEASURES TO OFFSET LOSSES BY BOLL WEEVIL.

Confidence—Just as one of the most serious factors is the feeling of discouragement when weevil injury becomes serious, just so one of the greatest helps is the return of confidence, or better yet, the holding of confidence from the start, knowing that other sections have been through the same experience and recovered. It is here that county agents, banks, chambers of commerce, and merchants can help in large degree. The resourceful farmer who still grows cotton, braced, backed and supplemented with other things, will still be good for his debts. The whole effort should be toward encouragement **based upon** what is called a "balanced agriculture." This does not at all mean that cotton must be abandoned.

Cultural Methods—By this we mean the planting of the best varieties of cotton, those which are known to do well under boll weevil conditions, and the use of fertilizers and methods of culture that will secure the largest possible crop, and if these get the crop assured before the weevil reaches its highest point of destructiveness in late summer, so much the better. Here, again, the advice of the county agent may help, or the farmer may write to the Division of Agronomy, West Raleigh, N. C., for advice on these points. At present, that division is recommending the following varieties for our weevil infested area: Wannamaker-Cleveland, Mexican Big Boll, Cooks (strain developed at Edgecombe branch station), and Lone Star for very light sandy soils. The cultural methods are very important in producing cotton where boll weevil is present.

Other Crops—These are to supplement cotton, to offset losses which weevil may inflict. Experience already acquired will indicate which crops can best be depended upon; corn, beans, peas, potatoes, peanuts, or others. These other crops should be increased enough, or more than enough to make up for any reduction in the cotton acreage. On these points the county agent, or the Division of Agronomy, West Raleigh, N. C., may be consulted if desired.

Reduction of Acreage—This matter will largely take care of itself, but it is best not to swing to extremes. If experience convinces a farmer that he must reduce the acreage in cotton, it is considered best to do so gradually; reducing from 10 to 20 per cent each year, always

planting other things to balance up; then, when confidence returns and experience points the way, increase again by the same gradual stages.

Livestock—This also, is designed to offset losses which the weevil may inflict. Some may decide to go into the livestock business largely, or even exclusively, but the majority of cotton farmers will perhaps increase their cattle or hogs to only moderate degree at first, enough to make up for decreased acreage in cotton and to make their credit good if cotton fails. In this the county agent may help, or the farmer may write to the Division of Animal Industry, West Raleigh, N. C., for suggestions.

SUMMARY AS TO CONFIDENCE, CULTURAL METHODS, OTHER CROPS.

Reduced Acreage and Livestock—At the present time, April, 1920, the subjects just mentioned, taken together, constitute the greatest part of the solution to the boll weevil problem, so far as it has been solved. They constitute the great sustaining force by means of which the cotton region has remained prosperous and has also continued to produce cotton, despite a tremendous amount of damage which the weevil has done during the same years.

Yet those measures and means, helpful as they are, do not lessen, kill, nor drive away the boll weevil. If, with the best of practice in these matters, a cotton farmer has to plant and attend to ten acres to get the yield which the same labor, without weevil, would give him on eight acres, then, no matter how prosperous he may be from these other operations, the weevil is still damaging his cotton to the extent of 20 per cent, and he is still the loser to the extent of what the yield of those extra two acres would be worth. That fact is inescapable, and we will next discuss those direct methods of fighting the weevil itself by which we may hope to lessen this remaining loss.

DIRECT METHODS AGAINST THE BOLL WEEVIL.

The writer, being an entomologist, is more especially concerned with the direct methods of fighting the weevil, than in the study of credits, varieties, fertilizers, other crops, or livestock. Under those other heads we have stated to whom the farmer may apply for information. In questions relating to the weevil itself, and the direct means of combating it, he may apply to county agent, or to Division of Entomology, State Department of Agriculture, Raleigh, N. C. We will endeavor here to cover fairly the chief direct methods of fighting the weevil, as known at present.

Picking Weevils from Plants—When the weevils come out of winter quarters in spring (April to June), they feed on the youngest leaves and in the terminals ("bud") until squares begin to form, after which

time they are to be found more numerously under the bracts ("shuck") of the squares, and still later under those of the bolls also. It will at once occur to the mind of the grower that these weevils might be gathered by hand, just as is often done with potato beetles. The best evidence, however, is that this is not profitable, or of doubtful profit. The weevils come out so irregularly that continuous picking is necessary, and the method is so slow that by the time the weevils are abundant enough to do really serious injury, it is out of the question. Yet it is practiced to some extent, and doubtless will continue to be. Certainly while chopping or doing other hand work in the cotton field, it will be well to kill such early weevils as are seen, but we would not recommend working over fields merely for the purpose of gathering weevils, and certainly it would be a mistake to assume that this method alone could be effective; especially in view of higher labor costs. On very small areas, or in special seed patches, it may be practicable.

Gathering Infested Squares—This consists of picking the infested squares, either from the ground or from the plants. Such squares turn pale, are apt to flare open and drop. They contain the eggs, grubs or pupae of the weevil, sometimes more than one in a square. These are the developing insects that have not yet reproduced, and the squares are quite easily seen. The gathering of the squares, therefore, is somewhat more practicable and effective than the gathering of the weevils, but, by itself alone, cannot be considered an adequate remedy. It is often suggested that the squares be raked or brushed into the center of the middles where they will be fully exposed and parched by the sun, thus preventing the development of the weevils. Some will prefer to gather into sacks and burn them.

At best, the method is of limited application, and is more available to the man with small acreage and abundant cheap labor, than to large acreages with expensive labor. The profit from this method will depend upon the thoroughness, rapidity, and frequency with which it is used. It is useless to gather squares that were attacked by weevils three weeks before, for weevils will already have emerged from them. If this method is to be depended upon at all, the squares should be gathered every week or ten days (every two weeks at least), and it is only profitable when infested squares are numerous enough to be gathered rapidly.

Getting Rid of Stalks in Fall—This is considered by all who have studied the subject, to be a very effective means of lessening the number of weevils that can pass the winter, thus assuring a less number to come into the fields in spring. Just how it is to be done, and just what cropping methods are to be followed to fit into the process, must be left largely for each farmer to determine. But the principle is sound; it is this: the weevil has no food plant but cotton, and many

die during the long period between the dying of cotton in the fall and the coming up of new cotton in the spring, hence, if we can lengthen the time that they must go without food by getting rid of the stalks **earlier than they would naturally die,** we greatly increase the winter death rate among the weevils.

In attempting to outline a plan, we at once encounter numerous difficulties. To be most effective, the stalks should be plowed out, gathered into windrows or piles and burned, but, aside from the matter of labor, this would destroy the needed humus. Another idea is to beat, break, or chop down the stalks and plow them under, but this may not easily be done while they are yet green. There would be the need of some winter crop to be immediately sown, and the practice would stand against the sowing of cover crops between the rows in early fall; it being necessary to postpone this until the cotton was picked and the stalks destroyed. A less effective plan would be merely to kill the plants with stalk chopper, or otherwise, as soon as the crop is picked (yet before they would naturally die, remember), but while this would have some effect many weevils would yet mature in the bolls and squares on the plants. We are fully aware also that much of our cotton is not picked until long after frost, far into the winter; while some of it is never picked at all. There yet remains the possibility of plowing out the stalks so as to kill them, even though picking is not yet completed, and gathering the remaining cotton afterward from the prostrate stalks.

Whatever the method, it must, to be effective, kill the stalks earlier than they would die by nature, so as to lengthen the time that the weevils must go without food.

While realizing fully that this method may never become widely practiced, and also the impossibility of outlining a plan for all to follow; yet, it is one of the most vulnerable points in the life of the weevil, and we are sure that there are often times when it can be taken advantage of. It is not uncommon to see fields of cotton which are picked early in fall in which no cover crop has been sown, and yet the stalks stand, not only until killed by frost, but until time to prepare for another crop the next year. In such cases, surely some way could be adopted to kill those stalks early in fall, thus causing more of the weevils to die before cotton is up in spring.

It may occur to the mind of the reader that late planting of cotton in spring would lengthen the time the weevils would be without food. True, but all experience shows that it is wholly erroneous to delay planting in spring for this reason. All circumstances demand planting the cotton as early as is safe.

Destroy the Over-wintering Weevils.—Experience shows that many weevils pass the winter in or very near the cotton fields, in trash, cracks in the ground, weedy growth along fence rows, ditch banks,

edge of woods, etc. Hence, all that can be done to do away with suc cover in fall or winter, earlier the better, will be of effect. Th whole subject will come under two words —"clean farming"— an every farmer can make his own plans for this. In connection wit this, it may be mentioned that when practicable some advantage i gained by planting the cotton as far as possible from favorable wi tering quarters so that fewer weevils will find it, and those not s readily.

Poisoning the Weevils.—This method has been experimented wit ever since the weevil became a serious factor in this country. It wa soon decided that Paris green was not profitable to use. Finally the development of the dry arsenate of lead powder, and the allie material known as calcium arsenate, gave more hope for this metho With further improvements in the materials, and the developmen of machines to thoroughly apply them, both of which are still i process, the poisoning method is now one of very good promise. W seem, indeed, to be upon the threshold of the time when poisonin will come into extensive use. There is hope for the development o machines suitable and profitable for use upon all sizes of fields. Th poison is applied in dry dust form.

The poisoning method is discussed in Bulletin 731 of the U. S Dept. Agriculture, Washington, D. C., by B. R. Coad, issued July 1918, entitled "Recent Experimental Work on Poisoning of Cotto Boll Weevils." All who wish to study this method should write fo this bulletin or others on this subject, more recent, which may b issued from Washington.

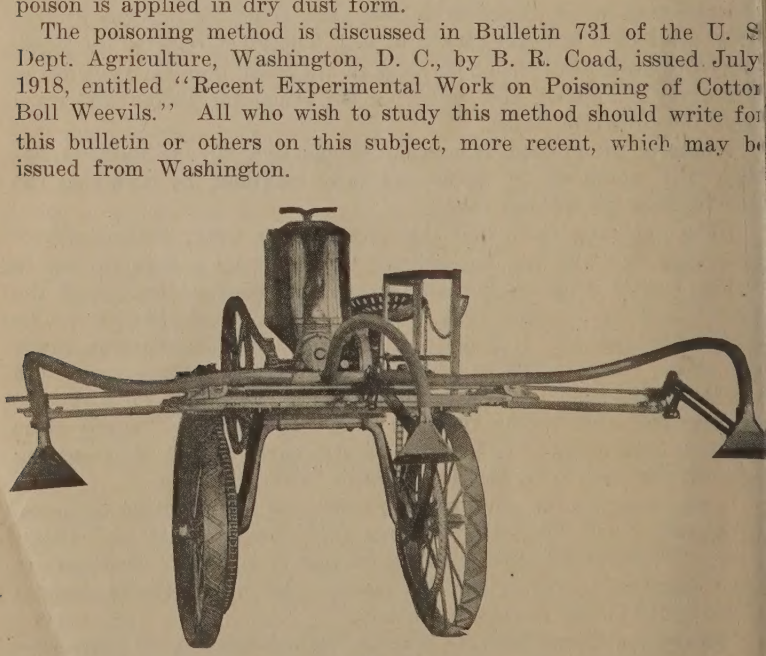

FIG. 7.

TRACTION DUSTER FOR COTTON. TREATS THREE ROWS AT ONCE.
(From Niagara Sprayer Co.)

The Niagara Sprayer Co., of Middleport, N. Y., with southern branch for cotton work at Vicksburg, Miss., has this winter (1919-1920), issued a special catalogue on cotton dusting machinery. The interested grower should get this catalogue also. While this is the first special catalogue of the kind that has yet come to hand, it is likely that other firms will soon come into the field. The same firm puts out poisons prepared for cotton dusting.

It might seem that the object would be to poison the weevils when they first come out in spring, but experience indicates that their emergence is too irregular and extends through too long a period to make this practicable. The best results have been secured from dustings given after the weevils have become numerous enough to destroy **more squares than the plants normally shed of themselves.** Without experience to guide us in this State, as yet, it seems probable that the dusting should begin in the latter part of July.

The experiments by Mr. Coad indicate calcium arsenate to be the material to use. Other tests under Mr. Wilmon Newell in Florida indicate as good results from powdered arsenate of lead. It is agreed that the poison should be very finely ground, so as to make a fine and fluffy dust; more fine than the usual dust poisons now on the market. The machine should be regulated to distribute about 5 pounds per acre. The poison is used pure, not diluted with lime or other materials. While it is thought that it may be more effective if applied while dew is on the plant (i.e., late evening, early morning, or even at night), yet the importance of this is not fully established, and good results have been secured from mid-day dustings. It is agreed that the dust should be put on with a blast, not merely sifted, and that the special object should be to blow it into the squares and 'bud,'' under the bracts of squares and bolls.

The number of applications will vary, according to how soon it is begun and how long continued. In the experiments it has varied from three separate treatments to five. To kill the weevils before they lay eggs requires frequent treatments, as often as once a week or even oftener for best results. There seems to be a decided advantage in several applications in quick succession, even if later in season they are given at longer intervals. We would estimate that, if the method develops well, the final practice in this State would be to give three to five dustings at intervals of about a week, beginning in late July or early August. This would be after most of the cultivation is over, and would make August the chief month for the work of poisoning cotton. This would also aid to some extent against the boll worm which often destroys an appreciable number of bolls, and would be effective against cotton caterpillar in the years when it is present.

It is to be remembered that the development of present poisoning

methods against the boll weevil is still new; it is not yet entire beyond the experimental stage, and it is likely that further improv ments will yet be made, but the present prospect is that this metho will soon be used much more generally than heretofore. Incidentall a machine which will dust cotton successfully ought to be useful fo Irish potatoes, tobacco and cabbage, to protect them from beetle and worms, and, in case of an outbreak like that of green clove worm on soy-beans in 1919, would be useful to a high degree. Als such a machine, with dry powdered sulphur instead of arsenat would offer a good hope for control of Red Spider on cotton.

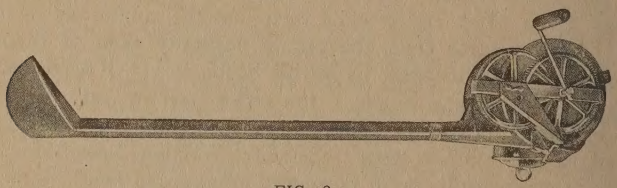

FIG. 8.

HAND DUSTER FOR COTTON.
(From Niagara Sprayer Co.)

The question of cost and returns must of course, be considered The cost will vary according to quantity of material purchased, and care in application. One would be able to do more economical work as he gains in experience. Perhaps it would be fair to estimate a cost of $1.50 an acre for labor and poison for each dusting.

The returns will vary also. In general terms, we may say a treatment costing $1.50 an acre appears to promise an average gain of 50 to 100 pounds seed cotton an acre. Four or five dustings at cost of $6.00 to $7.50 an acre might be expected to give a gain of 200 to 500 pounds seed cotton an acre. Of course, this is merely suggestive —the returns are sure to be highly variable. One very thorough and well timed dusting in a bad weevil year might give a greater profit than three less fortunate dustings in other years.

KEEP POSTED.

The farmer should ascertain from time to time what new publications and new ideas may have appeared. At this time (April, 1920), two recent and instructive bulletins on the subject may be had by applying to U. S. Dept. Agriculture, Washington, D. C. These are:

Farmers Bulletin 848 "The Boll Weevil Problem," by W. D. Hunter.

Bulletin 731 "Recent Experimental Work on Poisoning Cotton Boll Weevils," by B. R. Coad.